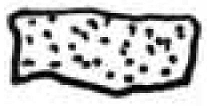
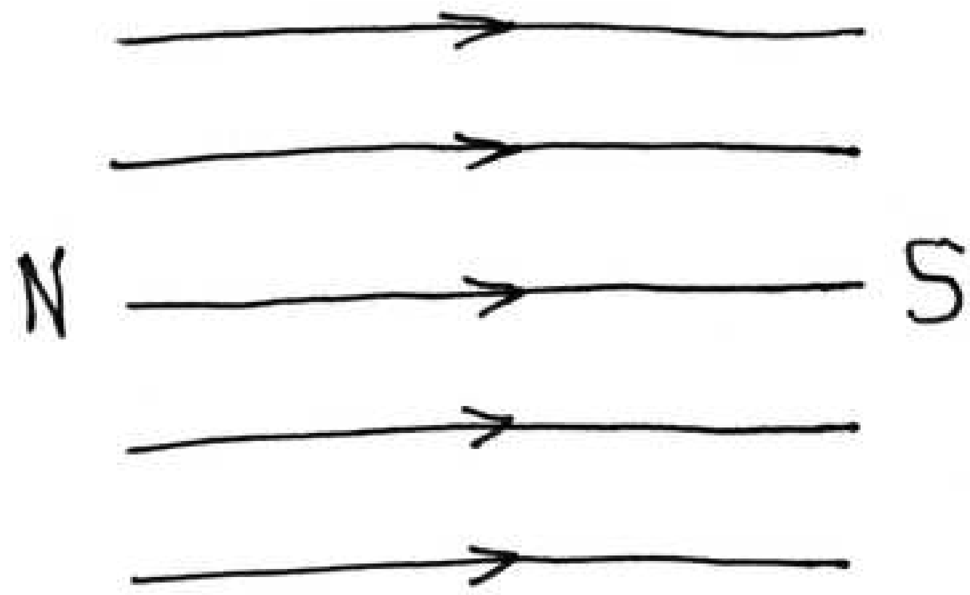
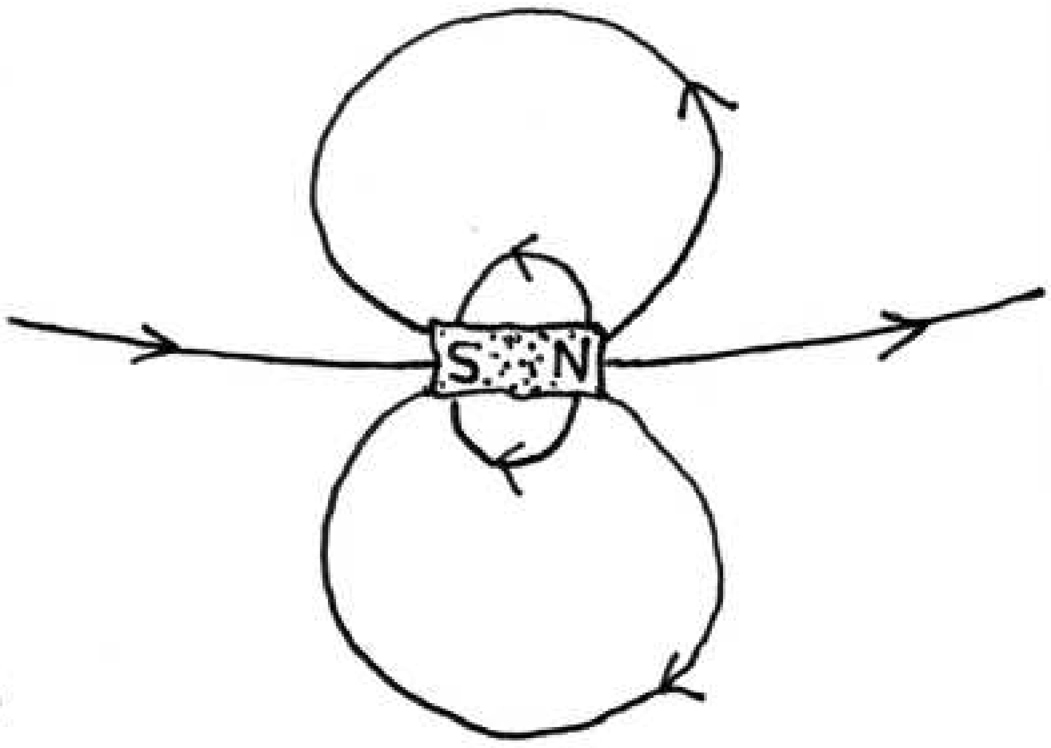
MAGNETIC POLARIZATION (aka Magnetization)

Here is an unmagnetized lump, say an iron filing: 
How does it respond to an external applied field?

(a) First let's sketch the applied field without the lump present:
The field lines are uniformly separated, indicating a constant magnetic ($\vec{B}$) vector field.

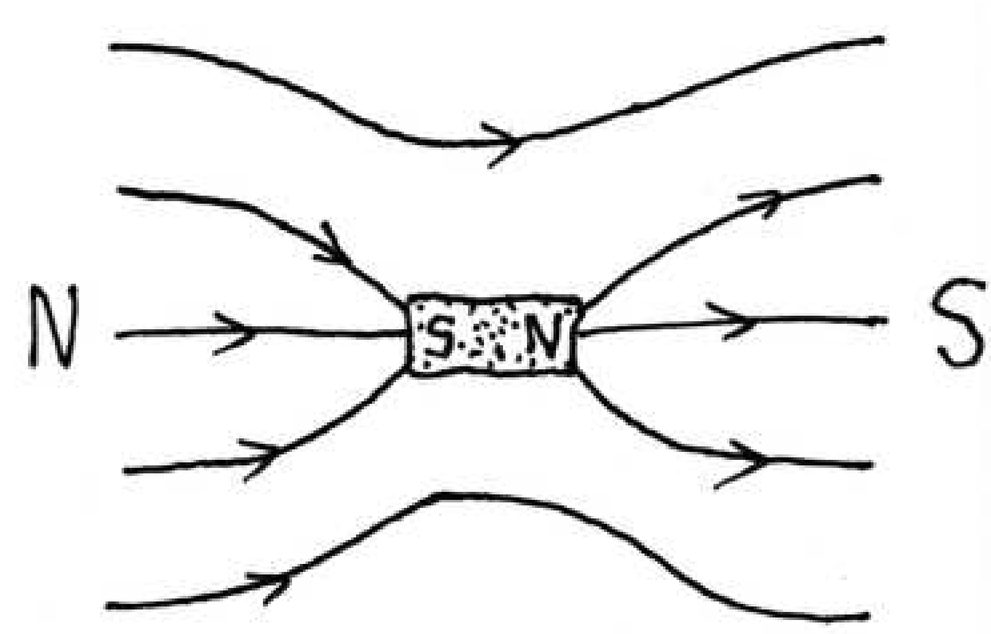


(b) Here is the extra (new) field induced when the lump is placed in the above applied field:
The lump creates its <u>own</u> North & South poles, and the resulting field pattern is called a "dipole".

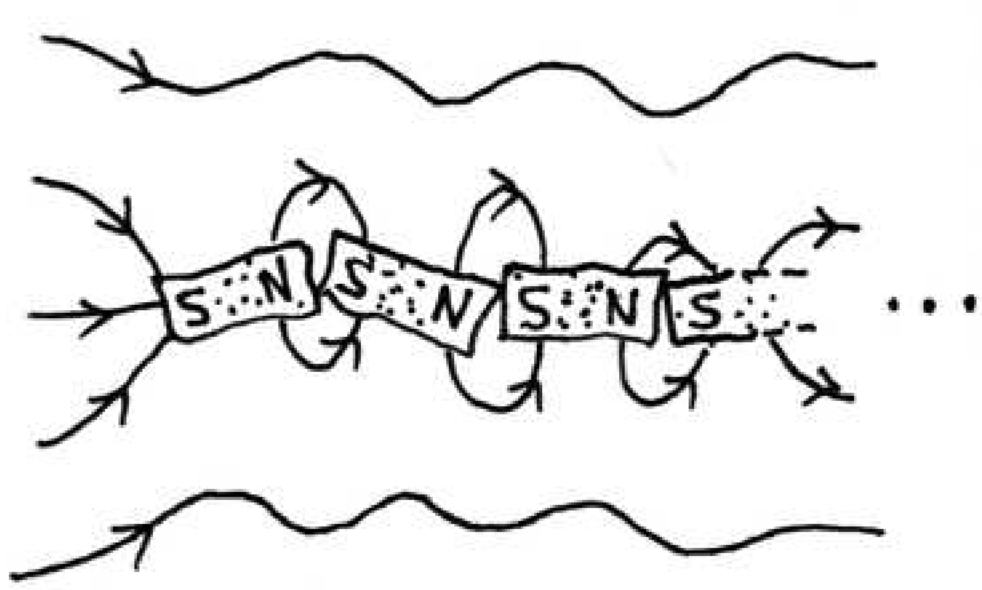


If the applied $\vec{B}$ is not too large, then the lump's magnetization is $\vec{M} = \chi \vec{B}$, where χ is the lump's "susceptibility".
χ is huge for iron (a ferromagnet), but small (& sometimes negative) for most other materials.

(c) The total (physical) $\vec{B}$ field is the sum (as vector fields) of the previous two pictures: Note the two high-field regions where the field lines come closest together.



(d) Minimizing the energy shows that a 2nd lump would be attracted to these high-field regions, explaining a tendency to "chain together" in the applied field:



(e) Due to microscopic domain flipping, iron usually retains residual magnetization (a weaker version of pattern (b) above), even after removing any applied field. Just like a compass needle, such a lump tend to rotate to align with whatever new field may be applied.

• Each of the above polarization phenomena provides fruitful analogies for humans in the external media environment: we are the ferromagnetic lumps responding to, and modulating, the media magnetic field.